Remarks/Arguments

Reconsideration of the above-identified application in view of the present amendment is respectfully requested.

By the present amendment, claims 8, 9, and 10 have been added to the application. Claim 8 recites that the low-carbon steel tube is cold drawn; claim 9 recites that low-carbon steel tube is seemless; and claim 10 recites the mechanical properties of the low-carbon steel tube as recited in claim 3.

Below is a discussion of the obviousness rejections of claims 1, 3, 5, and 7-10.

35 U.S.C. §103 rejection of claims 1 and 3 in view of U.S. Patent No. 6,290,789

Claims 1 and 3 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,290,789 to Toyooka et al. (hereinafter, "the '789 patent").

Claim 1 is patentable over the '789 patent because: (1) the '789 patent does not teach or suggest a low-carbon steel tube that yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low-carbon steel tube to so yield is applied to the low-carbon steel tube, and (2) the induction heated low-carbon steel tube of claim 1 exhibits unexpected result.

The '789 patent teaches a low-carbon steel tube having a composition that overlaps the composition recited in claim 1. The Office Action states, however, that the '789 patent does not teach a low-carbon steel tube that yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low-carbon steel tube to so yield is applied to the low-carbon

steel tube. The Office Action argues that this plastic property is obvious because the claimed composition and the composition recited in claim 1 are substantially identical to the composition of the '789 patent; therefore the claimed properties are inherent.

The plastic properties recited in claim 1 are not obvious in view of the '789 patent because the composition of the '789 is not substantially similar or identical to the composition recited in claim 1. As noted in the Office Action, the Federal Circuit has held that where the claimed invention and prior art products are <u>identical</u> or <u>substantially identical</u> in structure or composition, or produced by identical or substantially identical processes, a prima facie case of obviousness has been established. The low-carbon steel tube does not have a composition that is substantially identical or identical to the composition of the low-carbon steel tube of the '789 patent; therefore, a prima facie case of obviousness is not established.

The low-carbon steel tube of claim 1 consists essentially of, by weight, about 0.07% to about 0.12% carbon, about 0.70% to about 1.60% manganese, up to about 0.020% phosphorous, up to about 0.015% sulfur, about 0.06% to about 0.35% silicon, about 0.25% to about 1.20% chromium, up to about 0.65% nickel, about 0.20% to about 0.70% molybdenum, up to about 0.35% copper, about 0.02% to about 0.06% aluminum, up to about 0.05% vanadium, up to about 0.25% residual elements, and the balance iron. In contrast, the '789 patent, as noted in the Office Action, teaches a low-carbon steel tube with broad ranges of components that potentially touch and overlap the percent amounts of the components of the steel composition recited in claim 1. Moreover, the specific ranges of claim 1 are not

taught or suggested by the '789 patent. None of the examples of the '789 patent teach a steel composition that falls within the percent amounts of the components recited in claim 1. Thus, the '789 patent merely teaches a broad range components that is neither identical or substantially identical to the claimed composition.

Additionally, a low-carbon steel tube formed using the steel composition recited claim 1 has substantially different mechanical properties than a low-carbon steel tube formed using the steel recited in the '789 patent. The low-carbon steel of claim 1 has a tensile strength of at least about 130,000 psi (896 MPa) and a yield strength of at least about 104,000 psi (717 MPa). None of steels listed in the '789 patent, in contrast to the Office Action's statement, has a tensile strength of at least 896 MPa or a yield strength of at least 717 MPa. Steels listed in the '789 patent that have the highest tensile strength and yield strength are Nos. 2-3, 2-11 (Table 4) and 3-5 (Table 6). Steels 2-3 and 2-11 have tensile strengths of respectively 730 MPa and 712 MPa; while steel 3-5 has a tensile strength of 724 MPa, all well below 896 MPa of the steel of claim 1. The yield strength of steels 2-3 and 2-11 are not listed; while the yield strength of steel 3-5 is 637 MPa, well below the 717 MPa of the steel claim 1. Further, these steels, 2-3, 2-11, and 3-5, as noted in Table 3 and Table 5 of the '789 patent, have compositions outside of the ranges recited in claim 1. Thus, steels taught in the '789 patent have different mechanical properties than the steels in claim 1.

Moreover, it well known to one skilled in the art that the mechanical properties of a low-carbon steel tube (and for that matter any article formed from steel) are a function of not just the composition of the low-carbon steel, but also of

the processes used to form the low-carbon steel into the low-carbon steel tube. The process used to form low-carbon steel tube recited in claim 1 is substantially different than the process recited in the '789 patent. Specifically, the low-carbon steel tube of claim 1 is cold-drawn and then induction heated. In contrast, the low-carbon steel tube of the '789 patent is hot-drawn by induction heating and then cooled.

Accordingly, the composition and process of forming the low-carbon steel tube of claim 1 is not substantially identical or identical to the composition or process of forming the low-carbon steel tube of the '789 patent. Furthermore, a retrospective view of inherency is not a substitute for some teaching or suggestion which supports the selection and use of the various elements of a claimed composition. In re Newell, 891 F. 2d 899, 13 USP2d 1248 (Fed Cir. 1989). Therefore, the plastic properties recited in claim 1 would not be inherent in view of the '789 patent.

Additionally, the low-carbon steel tube recited in claim 1, exhibits unexpected results compared to the low carbon steel tube recited in the '789 patent. As noted in the Declaration under 37 CFR 1.132 provided in the October 24, 2006 response, from Mr. Erike, a senior technical specialist with over 20 years experience in materials engineering and metallurgy, an induction heated low-carbon steel tube having a composition as claimed exhibits unexpected properties compared to a convention heat-treated low-carbon steel tube having a similar composition.

Specifically, Mr. Erike states that:

> It is common knowledge that steels exhibit a ductile-to-brittle fracture transition at low temperatures. The ductile-to-brittle fracture transition is a marked change in fracture resistance of steel with changes in one or more test variables. It occurs only in certain steels within ranges that depend on the steel. Temperature,

stress state, and strain rate are among the variables that can give rise to fracture transition.

Experiments were performed comparing the maximum temperature of brittle area outbreak and tensile strength for examples (Ex. 1-3) of low-carbon steels having similar compositions but processed into seamless tubes using different processes. The results are plotted in the attached graph. For each of the examples 1-3, the low-carbon steel used to form the seamless tubes consisted essentially of, by weight, about 0.07% to about 0.12% carbon, about 0.7% to about 1.60% manganese, up to about 0.020% phosphorous, up to about 0.015% sulfur, about 0.06% to about 0.35% silicon, about 0.25% to about 1.20% chromium, up to about 0.65% nickel, about 0.20% to about 0.70% molybdenum, up to about 0.35% copper, about 0.02% to about 0.06% aluminum, up to about 0.05% vanadium, up to about 0.25% residual elements, and the balance iron. The maximum temperature of brittle area outbreak was determined using a Charpy V-impact test on steel samples obtained from seamless low carbon steel tubes formed by the different processes. The tensile strength of steel samples obtained from seamless low carbon steel tubes formed by the different processes was measured in accordance with ASTM E8/E8M. In each of examples 1-3, the low carbon steel was cast, hot rolled to form a cylindrical billet, and then pierced to form a tube. The low carbon steel tube of example 1 was then quench tempered to a temperature of about 620°C and then cold drawn to form a seamless tube. The low carbon steel tube of example 2, after piercing, was cold drawn and quench tempered to a temperature of about 520°C. The low carbon steel tube of example 3, after piercing, was cold drawn and then induction heated to a temperature of about 520°C.

The low-carbon steel of example 1 had a tensile strength of about 925 N/mm^2 and maximum temperature of brittle area outbreak of about -20°C. The low-carbon steel of example 1 had a tensile strength of about 912 N/mm^2 and maximum temperature of brittle area outbreak of about -80°C. The low-carbon steel of example 1 had a tensile strength of about 925 N/mm^2 and maximum temperature of brittle area outbreak of about -105°C.

> The low carbon steel of example 3, which was heat treated by induction heating, exhibited a remarkable improvement in maximum temperature of brittle area outbreak compared to the low carbon steel of examples 1 and 2 remaining ductile and plastic at temperatures below -100°C.
>
> Based on my experience in low carbon steel engineering and seamless tube fabrication as well as my review of low-carbon steel and seamless tube fabrication literature, a low-carbon steel having plasticity down to about
>
> -100°C has not been previously formed. Additionally, based on my experience in low carbon steel engineering and seamless tube fabrication, it would not be reasonable to expect that an low carbon steel heat treated by an induction heating process would out perform the same material produced with gas or electric furnace heat treatment process.

Thus, it is unexpected that an induction heated low-carbon steel tube having a composition as recited in claim 1 would exhibit substantially improved ductility properties at temperatures down to -100°C compared to a low-carbon steel tube having a similar composition but heat treated by conventional heat treatment process.

Moreover, as noted in U.S. Patent No. 6,386,583, from which the present application claim priority, the steel of the present invention compared to low-carbon steels in the prior art has substantially improved mechanical properties (see tensile strength and yield strength noted above), exhibits no evidence of stress corrosion cracking when welded and subjected to a saturated air atmosphere at 80 C, and no evidence of hydrogen embrittlement upon welding. Therefore, the low-carbon steel

tube of claim 1 exhibits unexpected results and withdrawal of the obviousness rejection of claim 1 is respectfully requested.

Claim 3 depends from claim 1 and further recites that the low-carbon steel tube has a tensile strength of at least about 130,000 psi, a yield strength of at least about 104,000 psi, and an elongation at break of at least about 14%.

Claim 3 is patentable over the '789 patent because of the aforementioned deficiencies in the rejection with respect to claim 1. Additionally, claim 3 is patentable over the '789 patent because the '789 patent does not teach or suggest a low-carbon steel that has a tensile strength of at least about 130,000 psi, a yield strength of at least about 104,000 psi, and an elongation at break of at least about 14%.

As discussed above, the '789 patent does not teach or suggest a steel that has a tensile strength of at least about 130,000 psi (896 MPa) and a yield strength of at least about 104,000 psi (717 MPa). The examples of the '789 patent do show steels with a "high speed" tensile strength of greater than 896 MPa, but "high speed" tensile strength is not the same as "Tensile strength", which is distinguished in the '789 patent. Moreover, even in the examples of the '789 patent that have a "high speed" tensile strength that fall within the range recited in claim 1, the composition of those examples falls outside the composition ranges recited in claim 1. Thus, the '789 patent does not teach or suggest all of the limitations of claim 3 and allowance of claim 3 is respectfully requested.

Claims 8 and 9 depend respectively from claim 1 and are therefore allowable because of the aforementioned deficiencies in the rejection with respect to claim 1 and because of the specific limitations recited in claims 8 and 9.

35 U.S.C. §103 rejection of claims 5 and 7 in view of the '789 patent and U.S. Patent No. 6,024,808 and Metals Handbook

Claims 5 and 7 were rejected under 35 U.S.C. §103(a) as being unpatentable over the '789 patent in view of U.S. Patent No. 6,024,808 (hereinafter the '808 patent) and Metals Handbook.

Claim 5 recites a method that comprises casting a billet of low-carbon steel. The billet of low-carbon steel has a first diameter and consists essentially of, by weight, about 0.07% to about 0.12% carbon, about 0.70% to about 1.60% manganese, up to about 0.020% phosphorous, up to about 0.015% sulfur, about 0.06% to about 0.35% silicon, about 0.25% to about 1.20% chromium, up to about 0.65% nickel, about 0.20% to about 0.70% molybdenum, up to about 0.35% copper, about 0.02% to about 0.06% aluminum, up to about 0.05% vanadium, up to about 0.25% residual elements, and the balance iron. The diameter of the billet of low-carbon steel is reduced by hot-rolling the billet. A tube is formed having an annular wall by piercing the billet. The thickness of the annular wall is reduced to a first thickness by cold drawing the tube. The tube is induction heated after cold drawing to form a low-carbon steel tube that yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low carbon steel tube to so yield is applied to the low-carbon steel tube.

Claim 5 is patentable over the '789 patent in view of the '808 patent and Metal Handbook because (1) the '789 patent in view of the '808 patent and Metal

Handbook do not teach or suggest cold drawing and then induction heating a low-carbon steel tube so that the low-carbon steel tube yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low-carbon steel tube to so yield is applied to the low-carbon steel tube; and (2) a low-carbon steel tube formed by the method of claim 5 exhibits unexpected results.

The '789 patent teaches a method of producing a steel pipe (Column 10, lines 10-11). The method includes heating the steel pipe to a temperature of 400 C to 750 C and then rolling and/or drawing the steel pipe (Column 10, lines 12-56). The '789 patent teaches that the heating can be performed by induction heating (Column 12, line 11+). The '789 patent, however, does not teach that the steel pipe is cold drawn and then induction heated. The '789 patent does not disclose or suggest cold drawing the steel pipe, and the induction heating is only associated with rolling or drawing the pipe.

Moreover, the '789 patent teaches away from cold drawing the pipe. The '789 patent states at column 10, lines 44-52 and column 12, lines 51-56, that drawing is set at a temperature not lower than 400 C.

> "At rolling temperatures lower than 400C not only the deformation resistance of the material increases as to make the rolling difficult, but also the working strain tends to remain due to insufficient recovery and recrystallization of the material." (Column 10, lines 48-52).

Thus, one skilled in the art would not cold draw the steel recited in the '789 patent because working stress in the steel would remain, which would lead to a decrease in ductility and toughness of the steel. (Column 12, lines 51-56).

Additionally, the '808 patent does not teach cold drawing the steel pipe and then induction heating the pipe nor would it be obvious to cold draw and induction heat the steel pipe of the '789 patent in view of the '808 patent.

With respect to the Office Action's argument that it would be obvious to cold draw the steel pipe of the '789 patent in view of Metal Handbook, the '789 patent, as discussed above, teaches away from such modification. One skilled in the art would not cold draw the steel pipe as argued by the Office Action because the '789 patent teaches away from drawing or rolling the steel pipe below 400 C.

Moreover, as discussed above with respect to claim 1, it is unexpected that a cold drawn induction heated low-carbon steel tube having a composition as recited in claim 1 would exhibit substantially improved ductility properties at temperatures down to -100°C compared to a low-carbon steel tube having a similar composition but heat treated by conventional heat treatment process. Therefore, withdrawal of the rejection of claim 5 is respectfully requested because the '789 patent in view of the '808 patent and Metals Handbook fail to teach or suggest all of the limitations of claim 5 and the method recited in claim 5 exhibits unexpected results.

Claim 10 depends from claim 5 and is therefore allowable because of the aforementioned deficiencies in the rejection with respect to claim 1 and because of the specific limitations recited in claim 10. Additionally, claim 10 is patentable over claim 1, because the '789 patent in view of the '808 patent and Metals Handbook do not teach or suggest a low-carbon steel that has a tensile strength of at least about 130,000 psi, a yield strength of at least about 104,000 psi, and an elongation at break of at least about 14%.

As discussed above the '789 patent does not teach or suggest a steel that has a tensile strength of at least about 130,000 psi (896 MPa) and a yield strength of at least about 104,000 psi (717 MPa). The examples of the '789 patent do show steels with a "high speed" tensile strength MPa of greater than 896 MPa, but "high speed" tensile strength is not the same as "Tensile strength", which is distinguished in the '789 patent. Moreover, even in the examples of the '789 patent that have a "high speed" tensile strength that fall within the range recited in claim 10, the composition of those examples falls outside the composition ranges recited in claim 10. The '808 patent and Metals Handbook do not correct the deficiencies of the '789 patent. Thus, the '789 patent in view of the '808 patent and Metal Handbook do not teach or suggest all of the limitations of claim 3 and allowance of claim 3 is respectfully requested.

35 U.S.C. §103 rejection of claim 7 in view of the '789 patent, the '808 patent, and the U.S. Patent No. 5,938,865

Claim 7 was rejected under 35 U.S.C. §103(a) as being unpatentable over the '789 patent, the '808 patent, and U.S. Patent No. 5,938,865 (hereinafter, "the '865 patent").

Claim 7 is patentable over '789 patent, the '808 patent, and the'865 patent because (1) the '789 patent in view of the '808 patent and the '865 patent do not teach or suggest cold drawing and then induction heating a low-carbon steel tube so that the low-carbon steel tube yields plastically more than about 5% before fracturing at temperatures down to about -100°C when stress sufficient to cause the low-carbon steel tube to so yield is applied to the low-carbon steel tube; and (2) a low-carbon steel tube formed by the method of claim 7 exhibits unexpected results.

As discussed above, the '789 patent does not disclose or suggest cold drawing the steel pipe, and the induction heating is only associated with rolling or drawing the pipe. The '789 patent, in fact, teaches away from cold drawing the tube. Additionally, the '808 patent and the '865 patent do not teach cold drawing the steel pipe and then induction heating the pipe nor would it be obvious to cold draw and induction heat the steel pipe of the '789 patent in view of the '808 patent and the '865 patent.

Additionally, as discussed above with respect to claim 1, it is unexpected that a cold drawn induction heated low-carbon steel tube having a composition as recited in claim 1 would exhibit substantially improved ductility properties at temperatures down to -100°C compared to a low-carbon steel tube having a similar composition but heat treated by conventional heat treatment processes. Therefore, withdrawal of the rejection of claim 5 is respectfully requested because the '789 patent in view of the '808 patent and the '865 patent fail to teach or suggest all of the limitations of claim 7 and the method recited in claim 7 exhibits unexpected results.

In view of the foregoing, it is respectfully submitted that the above-identified application is in condition for allowance, and allowance of the above-identified application is respectfully requested.

Please charge any deficiencies or credit any overpayment in the fees for this amendment to our Deposit Account No. 20-0090.

Respectfully submitted,

Richard A. Sutkus
Reg. No. 43,941

Tarolli, Sundheim, Covell
& Tummino L.L.P.
1300 East Ninth Street, Suite 1700
Cleveland, OH 44114
(216) 621-2234
(216) 621-4072 (Facsimile)
Customer No. 26, 294